Civil & Environmental Engineering 141
Design of Steel Structures
Final Exam
Fall 2017

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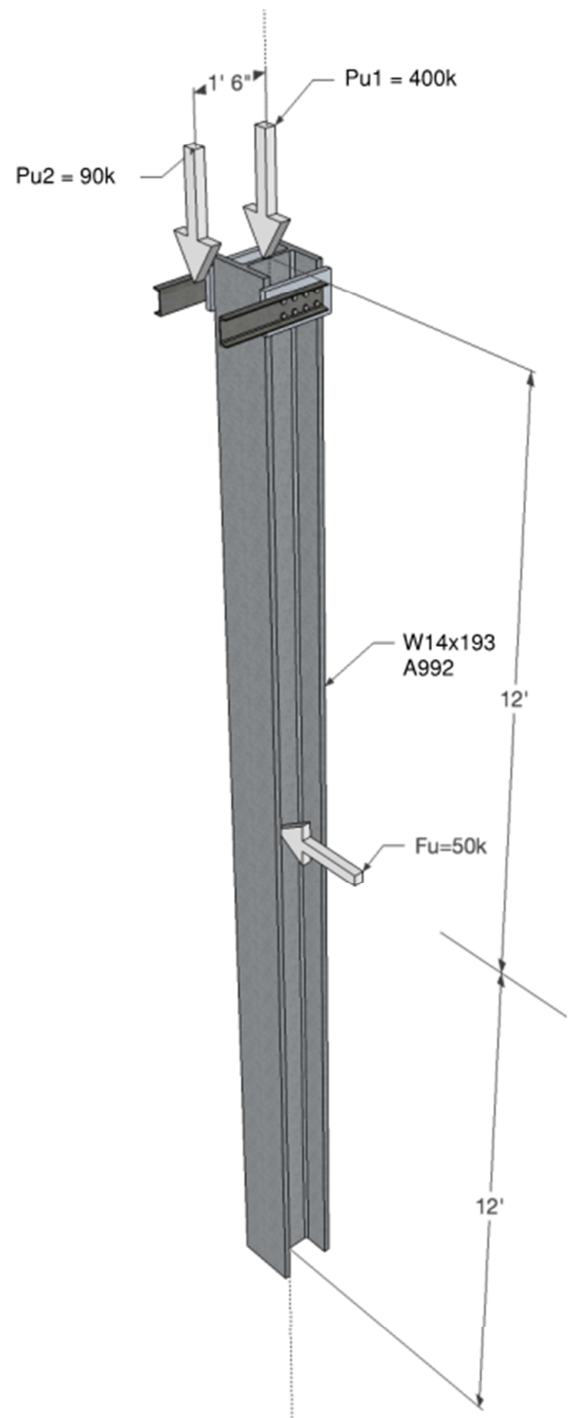
Problem 3: 30 points

The column shown is subjected to axial loads, Pu1 and Pu2, and a transverse load Fu (loads include all LRFD load factors). The eccentricity of load Pu2 causes a moment about the strong axis of the column and the direction of load Fu causes a moment about the weak axis of the column.

Assume the ends of the column are laterally supported in both directions and pinned to allow rotation. No lateral support is provided between the ends.

Determine whether the beam-column has adequate strength for the applied loads. Consider second-order effects and calculate values of Cm and Cb, if applicable. (Assume the moment due to Pu2 is applied at the top support of the column).



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Problem 4: 35 points

The 35 foot long composite, W18x35 beam shown below supports a uniform distributed live load.

Determine the maximum allowable live load, wL, that can be supported by the composite steel beam considering both strength and deflection limit states.

Assumptions:
• Consider only the applied load wL, and ignore loads due to self-weight of the beam and slab.
• You do not need to check pre-composite strength or deflection.
• Fy = 70 ksi for the steel section. E remains 29,000 ksi. All other behavior is consistent with typical steel design.
• The 6" concrete slab has f'c = 5000 psi.
• There are enough headed studs to develop the full capacity of the composite section.
• The effective flange width, be = 80".
• Calculate the lower bound moment of inertia to determine the deflection.
• The concrete slab fully braces the top flange

Hint: use the total compression force in the concrete for ∑Qn.